Scrap Tire Pyrolysis
Has Its Time Finally Arrived?
About Ray Riek

Career in commercializing new products and processes

Director R&D/Engineering at Monsanto for several chemical businesses
  ◦ Including Rubber Chemicals

Consultant in development and commercialization of new technologies (GOJO – Purell™, Avery Dennison, etc.)

CEO/Founder of Carbolytic Materials Company (pyrolysis of tires) 2007-2011
What if Scrap Tire Pyrolysis REALLY works?

From each tire processed:
- 10 pounds (1+ gallon) of oil derived from polymers
- 6 pounds carbon black recovered
- 2 pounds syngas
- 3 pounds steel

Financial overview
- Oil: good margins when crude oil is over $80/bbl
- Carbon black: good margins when crude oil is over $40/bbl
  - Higher volumes lower breakeven point
- Can be economically viable even with low price oil
Brief History

First operators were enticed by oil
- Operated with a more complete reaction to maximize oil production (depolymerization of the polymers).
- Only financially viable when oil price is high - responsible for many of the early failures
- Carbon black over-cooked (and named “char”), which has no performance market

Second wave (2000+) refined pyrolysis operations to recover carbon black – a high value reinforcing material in rubber products
- Modified reaction operations to recover carbon black without thermal damage
- Developed “finishing” process (milling/pelletizing/packaging) and established market for recycled carbon black
Where is the Industry now?

Recovered carbon black product has been accepted in the marketplace

- **This accomplishment has made the pyrolysis business financially viable**
- Those in operation typically are sold out to the limit of their capacity
- Will sell as-is to market of at least 300 million pounds (NA)
  - Plastics, as a colorant
  - Industrial rubber products (belts, hoses, gaskets, etc.)
  - Off-road tires: agricultural, fork truck, etc.
- Customers are “available” but require significant time investment for technical qualification

Pyro oil is typically sold for heating or as a blending oil with recyclers

- Pricing norm is 40-50% of benchmark crude

No one to date is profitable due to both scale and operational problems
The Recovered Carbon Product

A combination of all the carbon black used to create a tire. When correctly produced:

- Performance in the range of a N500-N700 “virgin” CB – which is the dominant material for sidewalls, gaskets, hoses and belts, with good tint strength (for pigmentation)

- Surprisingly matches “virgin” performance, even with dilution of 15% inorganics (Zn, S)

- Product “finished” (milled and pelletized) to be a direct replacement or blend with “virgin” CB to avoid customer issues in handling, processing, storage

- Replaces a product that has a huge carbon footprint (CB is manufactured by burning oil with 2 pounds $\text{CO}_2$ produced for every pound of CB produced)
Why not successful today?

Three issues holding back financial success

Pyrolysis technology incompletely developed
  ◦ Poor on-stream times for continuous reactors

Not well understood that this is a chemical business with technically oriented customers
  ◦ Incompletely staffed Operations, Marketing, Technical support

Capital intensive: typically funded to build a small scale plant
  ◦ Fund-limited for improvement, expansion capital and engineering
Next steps – “Nobel Prize” NOT required

Technology evolution
- “Bones” are there – generally needs engineering upgrades with experienced engineering resources
  - Have seen good engineering design solutions to existing issues. Simply a matter of funding and commitment
- Avoid metallurgy, thermal expansion, equipment protection, maintenance protocols, and scale-up issues that show up in the first 1000+ hours continuous operation
- Amazing “backwards” history of building a facility, then searching for markets and customers and learning how to make acceptable products

Staffing
- Beyond entrepreneurial stage: requires solid operations, marketing, technical and FINANCING skills

Funding commitment to complete technology evolution and expand capacity
- >> $25 million – most are not funded well with committed backers
- Implies strategic partnerships within the industry is the future (CB, rubber or plastic company)
Operational Scale

Carbon income drives the economics
  ◦ Must understand the marketplace, and staff to sell to technically oriented customers

Most agree that a 70-100 ton per day (tire input) operation is required to get investment grade returns
  ◦ Typical new facilities are 20-40 ton modules
Who’s Who in Tire Pyrolysis (actually made carbon sales)

Delta Energy:
- First to market a milled/pelletized product but limited operations from pilot facility
- Commercial facility now operating in Natchez Mississippi since 2016

- Carbolytic Materials Company (CMC): Out of business – a financial casualty; facility bought at auction late 2014 by Maryville Carbon Solutions
  - First continuous operation of commercial scale with over 7 million pounds carbon sold

Maryville Carbon Solutions (Bolder Industries)
- Started pyrolysis operations February 2017 in Maryville MO. Has provided carbon milling/pelletizing and packaging services since 2015.
- Operates both continuous and batch technologies
Who’s Who in Tire Pyrolysis (actually made carbon sales), continued

Reklaim:
◦ Sold carbon and oil from a commercial facility in Oregon. Recently purchased by Pyrolyx.

Pyrolyx:
◦ Purchased CCT (Potsdam, Germany) in 2015 – batch technology; currently selling carbon in Europe
◦ Purchased Reklaim, in design/construction phase of facility in Terra Haute, IN.

AES (Alternative Environmental Systems):
◦ Specialty applications of recovered carbon. Facility in Boise ID, HQ in LV Nevada

Several startups not listed here that are too early to list, or choose privacy
Summary

The probability of successful Tire Pyrolysis commercialization has improved substantially

- Is now an attractive commercial investment

Probability of success is no longer dependent on inventions, discovery or even market development

To succeed, the largest need is a patient investor willing to assemble the technical, marketing and operating skills to “put all the pieces together”

Likely to be an enterprise supported by a strategic investor

- Timeframe probability within the next 3-5 years
QUESTIONS & FURTHER DISCUSSION

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